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The traditional food use of wild vegetables in Apulia (Italy) in the light of Italian ethnobotanical literature

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Abstract

In this work, we present a summary of an ethnobotanical research carried out in the whole Administrative Region of Apulia (southern Italy). The main topic of the investigation is the traditional knowledge about wild plants, focusing on their common names, on which parts were used in cooking and how they were used. The main aim was to establish a botanical knowledge about these culinary uses through a systematic identification of the species involved, directly in the field. In addition to this, we focused on the ecological aspects of these species and on their biological and chorological forms. Results suggest the existence of very strong ties between the local communities and this particular flora, without substantial differences between rural and urban areas or among different zones of the Apulia Region. On the other hand, in each area we found peculiar food uses, species, parts used, and recipes. The analysed wild plants still have a fundamental role in the local diet, which can predominantly be ascribed to the Mediterranean model. Moreover, we documented an increasing interest in the culinary uses of these species: in the Gargano area, for instance, more and more cultivations of *Salicornia perennans* Willd. subsp. *perennans* are underway thanks to the demand coming from restaurants. In total, we documented 214 taxa (58 families) and at least 19 of them are enduring components of the local diet. Nineteen species represent a high number, considering that the tertiary sector is nowadays predominant in Apulia (73.5 % of the local GDP, compared to 73.2 % in Italy as a whole). Furthermore, the total amount of wild species used as food is the highest in Italy, according to the Italian ethnobotanical literature. On the same basis, we were able to draft a national checklist of 539 taxa documenting the taxonomy of the wild plants involved in traditional food use in Italy, categorized by regions. In conclusion, this work shows that the available literature regarding the Italian territory provides only a partial representation of traditional food uses, even though they are widespread throughout the country. Consequently, this tradition remains to be thoroughly investigated.

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Keywords
Ethnobotany, Wild Food Plants, Apulia, Italy

Introduction

The first major botanical work on the spontaneous Italian flora traditionally used for food purposes dates back to the 1980s (Aliotta 1987). For the first time, the spontaneous species that still had food use were described, with a focus on used parts and culinary preparations. Aliotta also listed the fruits and the spices (species with aromatic properties) people used. Only recently, a database has been published (Guarrera 2006b), describing the state of the art on folk uses (food use, too) of wild plants. The data is very heterogeneous and was collected in different years. Subsequently researches have been focusing on food uses thanks to which have a general overview of the species of food use characterizing the Italian tradition (Ghirardini et al. 2007, Caneva et al. 2013). In total, we acknowledge 828 edible units (Camangi et al. 2013) of this kind, which constitute more than 50 % of the ca. 1600 species reported for the whole European continent (Couplan 2009). This high number also includes fruits (even cultivated species) and plant parts used for flavouring preparations or for liquors. In the present work, we chose to consider only the spontaneous species and, in particular, those used as "vegetables", whose parts are harvested in large amounts (especially leaves) and used as fundamental ingredients in the main meals of a regular day. Therefore, we excluded fruits and aromatic plants, e.g., *Origanum heracleoticum* L., from our study. Also, the number of plants considered in the work by Camangi et al. (2013) does not fully account for inter- and intra-specific variability, because very often species belonging to the same genus or similar species were put together and, in some cases, only the genus was indicated. In conclusion, knowledge about food uses of plants is still restricted, even on a regional scale, despite thorough investigations have been conducted in central and northern Italy, namely in Piemonte (Mattirolo et al. 2001, Gibelli 2004, Pieroni and Giusti 2009), Toscana (Corsi and Pagni 1979, Pieroni 2000, Giusti and Pieroni 2009, Signorini et al. 2007, Camangi et al. 2007), and Lazio (Guarrera 1994, 2006b). A major comparative study about this tradition was also performed in southern Italy (Guarrera and Leporatti 2007) and some recent investigations about food use of wild plants were conducted in some areas of Basilicata (Cassandra and Pieroni 2015, Sansanelli et al. 2017) and in Sicilia (Aleo et al. 2013). Very recently, Regional data was released for Sardegna (Camarda et al. 2017) and Umbria (Ranfa and Bodesmo 2017).

Ethnobotanical research work in Apulia is still scarce and even less is known about food uses. What we know is due to very few studies (Corrain 1962, Picchi and Pieroni 2005, Guarrera 2006a, Leporatti and Guarrera 2007, Accogli and Marchiori 2009, Nardone et al. 2012) and, only recently, some of them have specifically considered food uses (Biscotti 2012, Biscotti and Pieroni 2015). Therefore, we acknowledged the strong need for an investigation about food uses of wild plants in the entire Region.

Materials and methods

Selected area

Apulia (Figure 1) is characterised by a predominantly flat territory (53.2 % lowlands, 43.5 % hills, 1.5 % mountains). The macrobioclimate is essentially Mediterranean (Rivas Martinez 1996, Pesaresi et al. 2014) throughout the Region, with the exception of the central part of Gargano, which has a temperate climate. The mountains (Murge, Serre Salentine, Gargano promontory) and the long coasts lead to different bioclimates, ranging from the Upper Thermomediterranean in Salento to the Lower Supra-temperate in Gargano (Biondi et al. 2008). Indeed, Apulia is a very interesting Region because of its biogeography, given that the Eastern Mediterranean flora and the peninsular flora meet here (Trotter 1913, Francini Corti 1966). From a vegetational point of view, the great potential of the Region is clearly represented by its holm oak (*Quercus ilex* L.) forests (Biondi et al. 2004). Morover, the Turkey oak (*Quercus cerris* L.) and European beech (*Fagus sylvatica* L.) forests that one finds in Gargano are quite unique (Biondi et al. 2008).

The tertiary sector is nowadays predominant in Apulia (73.5 % of the local GDP, compared to 73.2 % for Italy as a whole), followed by the secondary industry (14.4 % of the local GDP compared to 12.2 % for southern Italy and 18.5 % for the whole country) (IPRES 2016). Tourism is relevant too: in 2015, the number of tourists visiting the Region was more than 3 million, with people coming from Germany, UK, France, and predominantly Russia (Agenzia Regionale per il Turismo, 2015). According to a study by UVAL-UVER-ISTAT (2012) the quality of life is not homogeneous , especially in terms of services, like public transport, education, and so on. In fact, the so-called "advanced" Apulia can be found only in a few areas, e.g., the Tavoliere delle Puglie area (Foggia), the Barletta-Trani area, the coast going from Bari to Brindisi, the Valle d'Itria area, and the surroundings of Lecce and Taranto. So-called belt-municipalities (Terra di Bari, the near-Murgia belt and the Lecce and Taranto areas) are common here. Moreover, one can distinguish intermediate municipalities and outlying districts (Monti Dauni, Murge, southern Salento). Finally there are territories defined as "ultra-outlying", such as the Gargano area. Based on these data, the predominant - and probably hidden - composition of the Region consists of small villages, increasingly subjected to a marginalization process characterised by demographic decline, high unemployment rate, and so on. A crucial role is played by the distance between these villages and the nearby cities, in which the tertiary industry is mainly localised. Interestingly, Apulia is still strongly dependent on agriculture and is even leader in this field thanks to some of its local products. Consequently, the communities living here, even in the cities, still reveal some aspects of the rural way of life.

Field study

In our investigations, we explored the entire Regional territory over a period of six years (2011–2017) examining 15 different communities, here defined as learning areas, at

Figure 1. Study area: Apulia region (Southern Italy).

the same time. They are representative of the eight economic-territorial systems of the region (Figure 2) as defined by the aforementioned UVAL-UVER-ISTAT (2012) study. The municipalities included in each of the learning areas and their territorial systems are listed in the supplementary Suppl. material 1: Table S1. On average, 30 individuals were interviewed for each area and up to 450 people constituted the entire sample falling within the following age groups: 60 % aged 50–90, 25 % 40–49, and 15 % 20–39. As for gender, women constitute 59 % of the sample. They are professionals, public employees, retired people, peasants, caterers, local experts, and common consumers. Several were local botanists and researchers. The interviews were carried out according to the ethnobotanical research methods (Camarda et al. 2005; Signorini et al. 2013). Thanks to these testimonies we were able to identify the sites where the wild plants were harvested. Finally, in same sites, we conducted floristic relevés in order to understand the ecological dynamics in which the plants are involved and to assess the degree of availability of the species.

The plant species that the informers told us about were identified according to Pignatti (1982). As for the nomenclature, we followed Bartolucci et al. (2018) and Galasso et al. (2018). Finally, samples of some of the species are now preserved in the *Herbarium Anconitanum* ANC (Marche Polytechnic University).

We analysed all the species that are traditionally used for culinary purposes, including those which are no longer used, but that can still be easily found in the literature and in

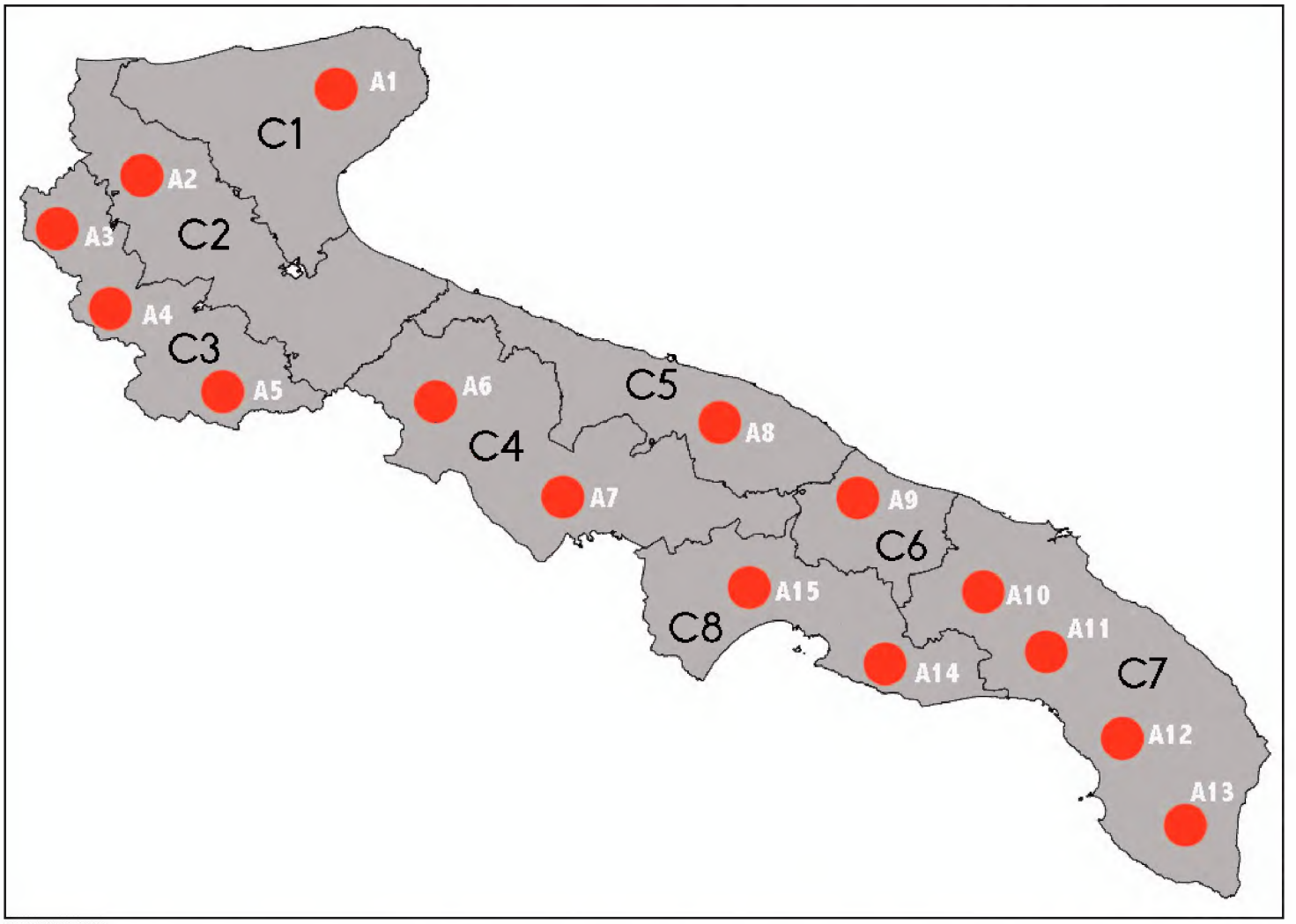

Figure 2. In the background the Apulian districts: Gargano (**C1**), Tavoliere delle Puglia (**C2**), Dauni Mountains for the province of Foggia (**C3**); Land of Bari murgiana (**C4**) and Terra di Bari (**C5**) for the province of Barletta-Andria-Trani and Bari; Valle d'Itria (**C6**) and Salento for the province of Brindisi and Lecce (**C7**); Ionic tarantine arch for the province of Taranto (**C8**). In the foreground red areas the study areas (15) for each district.

oral testimonies. The recorded species are listed in the supplementary Suppl. material 1: Table S2, which has been structured following ethnobotanical criteria, as previously used in research on Apulia (Biscotti and Pieroni 2015): local names, used parts, traditional culinary uses, frequency of citation [VC – very common: quoted by 40 % (n = 180) of the informants or more; C – common: quoted by 10–39 % (n = 45-179) of the informants; R – rare: quoted by less than 10 % (n = 1–44) of the informants; A – disused].

For a deeper understanding of the findings, we consulted the ethnobotanical bibliography that considered food uses in Italy. Apart from the database of Guarrera (2006b), the fundamental literature has been: Abruzzo (Manzi 1987, 1999, Idolo et al. 2010); Basilicata (Giusti et al. 2002, Pieroni et al. 2005, Guarrera et al. 2006, Cassandra and Pieroni 2015); Calabria (Passalacqua et al. 2006, Nebel et al. 2006); Campania (Scherrer et al. 2005, De Natale et al. 2009, Salerno and Guarrera 2008, Motti et al. 2009, Guarino et al. 2008); Emilia-Romagna (Sansanelli et al. 2014); Friuli Venezia Giulia (Paoletti et al. 1995, Dreon and Paoletti 2009, Cassandra and Pieroni 2015); Lazio (Guarrera 1994); Liguria (Bisio and Minuto 1999, Maccioni et al. 2004); Molise (Menale et al. 2006, di Tizio et al. 2012); Piemonte (Mattirolo et al. 2001, Gibelli 2004, Pieroni and Giusti 2009); Puglia (Corrain 1962, Picchi and Pieroni 2005, Guarrera 2006a, Leporatti and

Guarrera 2007, Accogli and Marchiori 2009, Nardone et al. 2012, Biscotti and Pieroni, 2015); Sardegna (Lancioni et al. 2007, Signorini et al. 2009, Camarda et al. 2017); Sicilia (Lentini and Venza 2007, Arcidiacono et al. 2010, Aleo et al. 2013); Toscana (Corsi and Pagni 1979, Pieroni 2000, Camangi et al. 2007, Signorini et al. 2007, Giusti and Pieroni 2009); Umbria (Ranfa et al. 2013; Ranfa and Bodesmo 2017); Veneto (Zuin 2010). We drew up a checklist (Suppl. material 1: Table S3) showing all the species found in the literature with their family (Peruzzi 2010), biological form, chorotype (Pignatti 1982) and the Regions in which they are used as food. The abbreviations used for the names of the Regions are: ABR (Abruzzo), BAS (Basilicata), CAL (Calabria), CAM (Campania), EMR (Emilia-Romagna), FVG (Friuli Venezia Giulia), LAZ (Lazio), LIG (Liguria), LOM (Lombardia), MAR (Marche), MOL (Molise), PIE (Piemonte), PUG (Puglia), SAR (Sardegna), SIC (Sicilia), TOS (Toscana), TAA (Trentino-Alto Adige), UMB (Umbria), VDA (Aosta Valley), VEN (Veneto) (Conti et al. 2005). As for the nomenclatural controversies, they were resolved according to The Plant List (http://www.theplantlist).

Data analysis

Based on data listed in the supplementary Suppl. material 1: Tables S2 and S3 we assembled two datasets with presence/absence data of 214 taxa × 8 districts (Apulian data) and 539 taxa × 19 regions (Italian data), respectively. We then obtained a dissimilarity matrix for each dataset by applying the function *vegdist* of the *vegan* package (Oksanen et al. 2015), method *jac*, in the open source software R (R Development Core Team 2015) and finally we conducted a cluster analysis with the function *hclust*, method *complete linkage* of the same package. The groups were visually seen with the *rect.hclust* function (k = 6). Finally, we used Venn diagrams to give a visual representation of the similarities.

Results

The species traditionally used in Apulia can be classified in 214 taxa, 201 specific and 13 subspecific (Suppl. material 1: Table S2), 42 of which are only used in this Region. Some of these 42 species belong to the genera *Allium* (*A. atroviolaceum* Boiss., *A. pendulinum* Ten.), *Crepis* (*C. apula* (Fiori) Babc., *C. rubra* L., *C. zacintha* (L.) Babc.), *Carduus* (*C. chrysacanthus* Ten., *C. nutans* subsp. *micropterus* (Borbás) Hayek, *C. nutans* subsp. *scabrisquamus* Arènes). Other species are typical of temperate forests (*Pulmonaria vallarsae* subsp. *apennina* (Cristof. & Puppi) L.Cecchi & Selvi). Some others belong to the complex genus *Taraxacum* (*T.* sect. *Erythrosperma* (H.Lindb.) Dahlst., *T.* sect. *Obovata* Soest, *T.* sect. *Scariosa* Hand.-Mazz.). Overall, we documented the use of species belonging to 58 families. Seventy-nine of our taxa are Asteraceae, closely followed by Brassicaceae and Apiaceae. These two families include several species commonly referred to as wild fennels, wild broccoli raabs, and wild celeries.

From a chorological point of view, most of the species are Steno-Mediterranean (26 %) and Euri-mediterranean (23 %). Strikingly, we found 67 species used only in one learning area. Seventy-four taxa are widely known throughout the Region, as expressed by their Frequency of Citation, and at least 19 of them are used in all the districts. Therefore, each community has followed very different paths in the process of using plants for food while the few species used everywhere [*Asparagus acutifolius*, *Diplotaxis tenuifolia* (L.) DC., *Muscari comosum* (L.) Mill., *Papaver rhoeas* L., *Helminthotheca echioides* (L.) Holub, *Scolymus hispanicus* Desf., *Sonchus asper* (L.) Hill, *Urospermum picroides* (L.) F.W.Schmidt] can now be acknowledged as the most characteristic food species for the Apulian tradition. Moreover, it is on a culinary level that biocultural differences proved to be stronger: what really differentiates the communities, in fact, is the role of the food taxa, e.g., whether it is used in association with pasta, with meat or with bread. We found many unique preparations here, such as the use of wild greens as ingredients of eel-based [*Taraxacum* sect. *Obovata*, *T.* sect. *Erythrosperma*] or lake fish-based [*Sonchus maritimus* L., *Tripolium pannonicum* (Jacq.) Dobrocz. s.l.] soups.

Culinary uses are many (around 20) and varied, as further proof of the great experimentation conducted in the search for raw materials and new recipes by the people inhabiting this land. Most commonly, they boil mixtures of plants, either alone or with stale bread ("pancotti"), and then dress them with abundant olive oil. In Monti Dauni (near Foggia), these mixtures are accompanied by fried bacon. The association of some of the recorded species [e.g., *Sonchus asper*, *Diplotaxis erucoides* (L.) DC., *Urospermum picroides*, *Foeniculum vulgare Mill.* subsp. *piperitum* (Ucria) Coutinho, *Scolymus hispanicus*] with homemade pasta is remarkable. We can now say that this fundamental association is very likely the basis of Apulian cooking. Indeed, one of the most characteristic dishes here is a type of pasta ("orecchiette") with broccoli raab.

Meat is widely used in recipes with wild plants too: for example, young leaves of *Eryngium campestre* L. are cooked with lamb. Furthermore, people use leaf stalks of *Sylibum marianum* (L.) Gaertn. in a veal stew, bulbs of *Muscari comosum* in lamb or goat casseroles, and leaves of *Urospermum dalechampii* (L.) F.W.Schmidt with sheep (local name of the recipe: "u callaridde"). Legumes are part of several recipes as well: fava beans, for instance, are cooked with *Sonchus asper* or *Urospermum picroides*. Dried beans, instead, are found in recipes having leaves of *Taraxacum* sp.

Finally, we documented a very common use of boiled *Salicornia fruticosa* L. and *Salicornia perennans* Willd. subsp. *perennans* either alone or as side dish in fish recipes. Recently, interest towards *Salicornia* sp. (salicornie, in Italian) has risen dramatically, especially in the Gargano area. We recorded other relevant uses of plants in fried recipes and omelettes. Wild greens are also stir-fried with olive oil and chilli, or roasted. For instance, shoots of *Smyrnium olusatrum* L. or young shoots of *Orobanche crenata* Forssk. are fried alone, while leaves of *Cichorium intybus* L. are fried with garlic and onion. On the contrary, leaves and young aerial parts of *Dioscorea communis* (L.) Caddick & Wilkin and *Asparagus acutifolius*, and bulbs of *Muscari comosum* are main ingredients of omelettes. Leaves of *Papaver rhoeas* and *Rumex acetosa* L. are stir-fried with

olive oil and chilli in Salento (local name of the recipe: "Paparina infuocata"). Tubers of *Asphodelus ramosus* L. or cloves of *Oxalis pes-caprae* L. are substitutes for potatoes in casseroles and roasts. Bulbs of *Allium ampeloprasum* L. are roasted, either directly or in hot ashes. Wild plants are commonly used as ingredients for salads or eaten raw as a snack with bread [leaves of *Helosciadium nodiflorum* (L.) W.D.J.Koch, *Allium ampeloprasum, Cerinthe major* L., *Diplotaxis tenuifolia, Diplotaxis viminea* (L.) DC., *Podospermum lacinatum* (L.) DC. subsp. *decumbens* (Guss.) Gemeinholzer & Greuter, *Portulaca oleracea* L., *Reichardia picroides* (L.) Roth, *Rorippa sylvestris* (L.) Besser, *Sonchus asper, Smyrnium olusatrum, Poterium sanguisorba* L., *Seseli tortuosum* L., *Dioscorea communis*]. Leaves of medicinal plants (*Ruscus aculeatus* L., *Dioscorea communis*), even those containing toxic compounds, are ingredients of soups and fried recipes (mostly they are stir-fried with olive oil and chilli). For example, young shoots of *Clematis vitalba* L. and *C. flammula* L. are used as food in the areas of Foggia and Bari and inthose of Lecce and Taranto, respectively.

From our literature survey, we report as unique the use of eating the stem marrow of *Silybum marianum* raw with salt, as usually done with celery. Several recipes listed here are fundamental to Apulian cooking and very often they are consumed during religious holidays, to which the local communities are still strongly tied. In general, the custom of using wild plants as food remains alive and it is very common to see wild plant-harvesters selling their "products" on the roadsides and in the local markets, mostly in the Foggia area, but also around Bari and Brindisi. These vendors are called "terrazzani" (Capozzi 2004) in Foggia and San Severo and mostly they sell *Asparagus officinalis* L., *Salicornia fruticosa* L., *Salicornia perennans* Willd. subsp. *perennans, Scolymus hispanicus, Orobanche crenata, Sonchus* sp., and *Muscari comosum*.

According to the informers we interviewed, consumers' fear of a residual presence of pesticides and other chemicals used in agriculture (flatlands around Foggia, Bari, Barletta, and Brindisi) is now a major factor in the reported lowering of wild plant harvesting. We also observed a reduction in the number of wild plants caused by the modernization of cropping patterns. Several wild species have found "refuge" in urban habitats, therefore becoming a fundamental part of the urban flora. However, it is still common to see (Gargano, Monti Dauni, Murge, Salento) people harvesting wild plants along the roadside and in wheat fields.

In Apulia, dialect names for plants are diverse, and can vary between neighbouring communities. Strikingly, 19 different local names were recorded for *Borago officinalis* L.: borrascine, burrasciana, burraccèlle, burraccedde, burrascina, burraccia, burracchia, burrascene, borracce, burracce, ferrascene, murraine, pezze de iarde, sucamele, verrascene, vorraine, vurraine, vurrascene, and verrascene, and 18 for *Muscari comosum*: ampascioni, bambasciale, bembascioele, cipudduzze, embasciole, jampasiune, lampascione, lampasciune, lambasciune, lambagione, lambascione, pampasciune, lembascione, pampascione, pampasciulu, pampascene, vambasciule and vampasciuli.

In our literature survey, we found a large number of species used for food throughout Italian Regions. However, only four (Table 1) are used everywhere: *Portulaca oleracea, Silybum marianum, Borago officinalis*, and *Cichorium intybus*. *Papaver rhoeas, Son-*

Table 1. Species with higher frequency in Italian regions.

Scientific name	Regional frequency
Borago officinalis L.	20
Cichorium intybus L.	20
Portulaca oleracea L.	20
Silybum marianum (L.) Gaertn.	20
Papaver rhoeas L.	19
Sonchus oleraceus L.	19
Taraxacum F.H.Wigg. sect. *Taraxacum*	18
Urtica dioica L.	18
Asparagus acutifolius L.	17
Capsella bursa-pastoris (L.) Medik.	15
Clematis vitalba L.	15
Humulus lupulus L.	15

chus oleraceus, and *Asparagus acutifolius* are used in 19, 18, and 17 Regions, respectively. Based on their frequency, *Silene vulgaris*, *Valerianella locusta,* and *Nasturtium officinale* R.Br. are representative of the tradition of northern Italy. Less frequent, but still typical, are *Chenopodium album* L. s.l., *Humulus lupulus* L., *Primula vulgaris* Huds., and *Salvia pratensis* L. Instead, *Capsella bursa-pastoris* (L.) Medik., *Chondrilla juncea* L., *Clematis vitalba, Cynara cardunculus* L. subsp. *cardunculus*, *Foeniculum vulgare* subsp. *piperitum*, *Reichardia picroides*, *Ruscus aculeatus*, *Rumex acetosa*, and *Urospermum dalechampii* are representative of central and southern Italy (species listed in decreasing order of frequency).

We noted that 241 taxa (44 % of the total) are used, each one, in just one Region, as a further proof of the extremely diversified culinary uses of wild plants in Italy. The number of taxa for each Region is shown in Fig. 3. Some species are non-native (e.g., *Agave* sp., *Robinia pseudoacacia* L.), while most belong to the Italian flora. Among the latter, species representative of the Italian phytogeographical diversity are: *Allium atroviolaceum* Boiss. (Apulia); *A. neapolitanum* Cirillo (Umbria); *A. ascalonicum* L. (Friuli Venezia Giulia); the genus *Lathyrus*, e.g., *L. articulatus* L., *L. ochrus* (L.) DC., *L. odoratus* L., and *L. sylvestris* L., in Sicily; *Ranunculus bulbosus* L., *R. lanuginosus* L., and *R. sardous* Crantz in Abruzzo, Sardegna, and Toscana, respectively; Iridaceae (*Moraea sisyrinchium* (L.) Ker Gawl.) in Basilicata; finally, species of the Violaceae, such as *Viola alba* Besser subsp. *dehnhardtii* (Ten.) W.Becker in Toscana, *V. mirabilis* L. in Friuli Venezia Giulia, and *V. reichenbachiana* Jordan ex Boreau in Liguria.

We also observed several peculiarities in terms of species and culinary uses: for instance, in Friuli Venezia Giulia *Equisetum arvense* L. and *E. telmateia* Ehrh. are used as components of mixtures. Leaves of *Asplenium ruta-muraria* L. are cooked with corn flour and eaten accompanied by milk. Interestingly, leaves of *Ficaria verna* Huds. (a toxic species) are eaten raw in salads (Dreon and Paoletti 2009) and the same occurs with *Lactuca virosa* L. in Basilicata (Sansanelli et al. 2017). In Umbria, *Rhagadiolus stellatus* rhizomes are also eaten (Ranfa and Bodesmo 2017). Instead, Sicilians tradi-

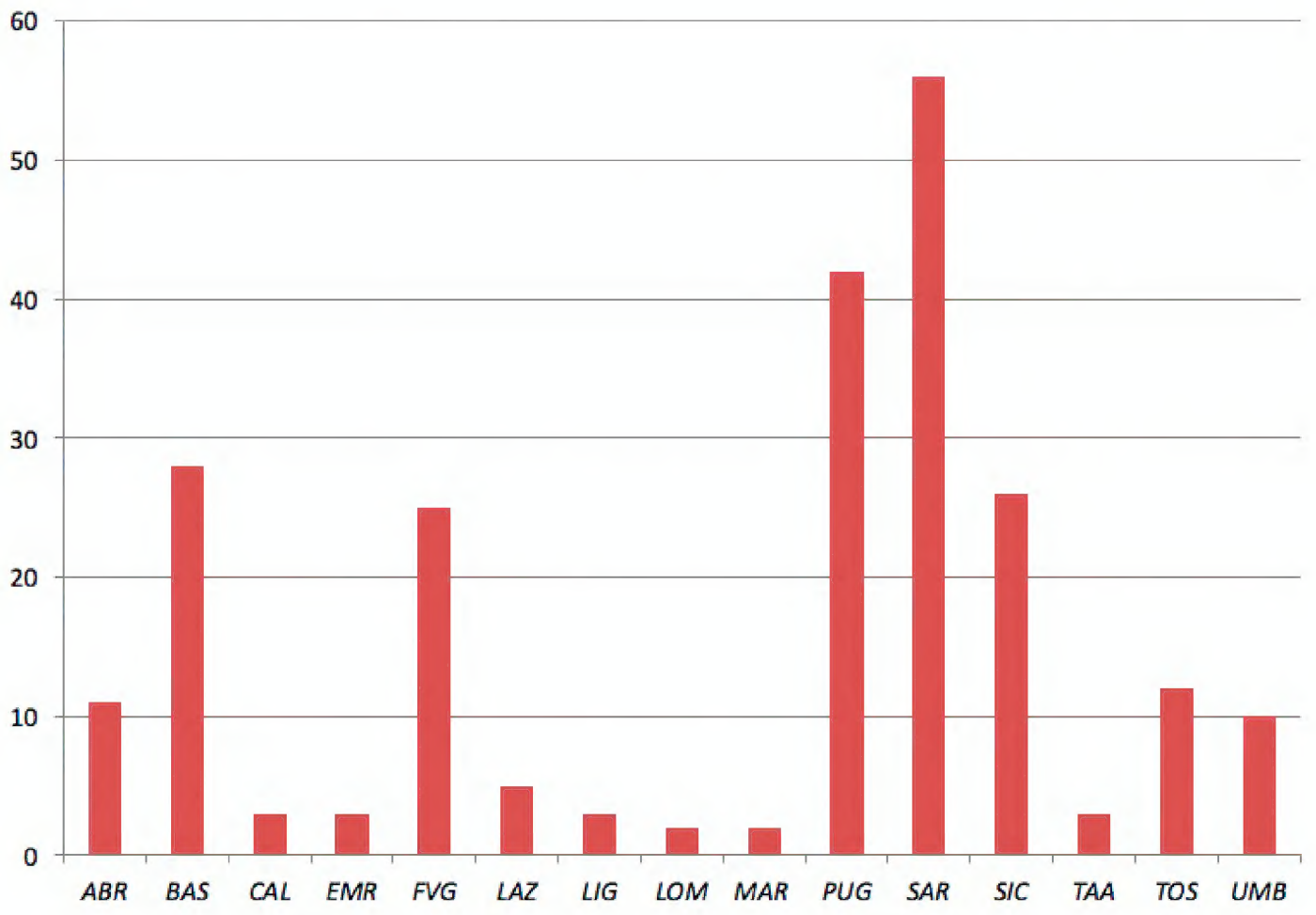

Figure 3. Number of exclusive wild taxa used as food for each region.

tionally roast bulbs and rhizomes of *Oxalis pes-caprae* (local names: castagnole and pinnuneddi, respectively) and boil leaves of *Lycium europaeum* L. (Arcidiacono et al. 2010). In Molise, leaves of *Urtica dioica* L. are boiled and eaten with ricotta cheese (di Tizio et al. 2012). In Basilicata, they grill roots of *Daucus carota* subsp. *carota* (Pieroni et al. 2005). The same is true for the stems of *Hermodactylus tuberosus* (L.) Salisb. in Sicily (Lentini and Venza 2007) and for *Asphodeline lutea* (L.) Rchb. and *A. liburnica* (Scop.) Rchb. in Apulia (Biscotti 2012). Also peculiar of the Italian tradition is the use of wild greens eaten raw with bread, often the lunch of local farmers. In fact, wild plants are commonly used in salads, according to the Italian "insalatiera" tradition (Firpo 1974); some species are basic components, such as *Portulaca oleracea*, while others are unique in the ethnobotanical literature, e.g., roots of *Onopordum illyricum* L., leaves of *Lactuca viminea* (L.) C.Presl, *Reseda alba* L. (Nebel et al. 2006), *Campanula rapunculus* L. (Ranfa and Bodesmo 2017), and *Podospermum laciniatum* subsp. *decumbens* (Biscotti 2012) and shoots of *Limbarda crithmoides* (L.) Dumort. s.l. (Scherrer et al. 2005).

Discussion

The flora traditionally used for food purposes in Puglia on the chorological level, is consistent with the flora of the region (Marchiori et al. 2000). At family level compared with the national data, interestingly, while 58 families in total are found in Italy,

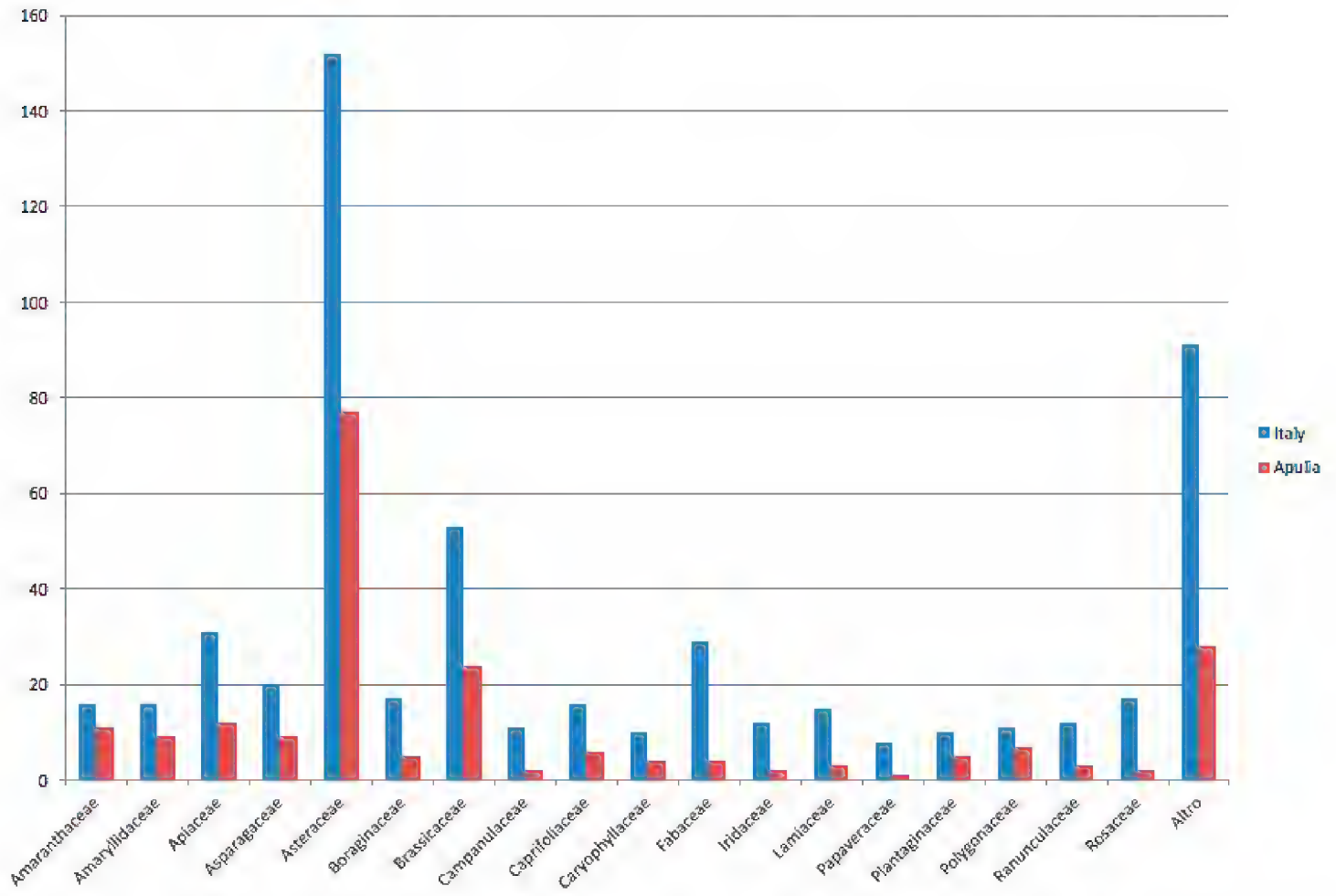

Figure 4. Comparison among families of wild species used in Italy (blue) and in Apulia (red) by number.

as many as 55 are found only in Apulia (Fig. 4). In Sardegna (223 documented species) this number decreases to 42 (Camarda et al. 2017) and includes fruit and aromatic plants. In Umbria (Ranfa and Bodesmo 2017), the documented species are 100 and the families 23.

Compared with other regions, Apulia shows a higher percentage of geophytes (Fig. 5), and shows a much more diversified culinary tradition, even though its territory is quite homogeneous in geographical terms.

Groups C1 to C8 include districts belonging to different geographical areas. It is only in the group on the right (C1, C2, C3) that we have districts of the same area (Foggia) (Fig. 6), very likely because of the common historical and economic backgrounds. In fact, wheat and sheep farming have always characterised the communities inhabiting these areas, from Gargano to Monti Dauni.

The wild plants are usually harvested in grasslands and arid scrubs that once were forests and then pastures, as we personally noticed by accompanying the informers. Nowadays, these areas frequently exhibit the features of grasslands of *Asphodelus ramosus* (= *Asphodelus microcarpus* Salzm. et Viv.); recently they have been included in the new *Charybdido pancratii-Asphodeletea ramosi* class (Biondi et al. 2016). Our floristic relevés revealed the presence of a considerable number of perennial plants (*Muscari comosum*, *Cichorium intybus*) and shrubs (*Asparagus acutifolius*, *Dioscorea communis*). Fires occurring in these areas often block their natural dynamic processes while favouring the growth of edible species. For instance, after a fire, *Asparagus acutifolius* can usually be

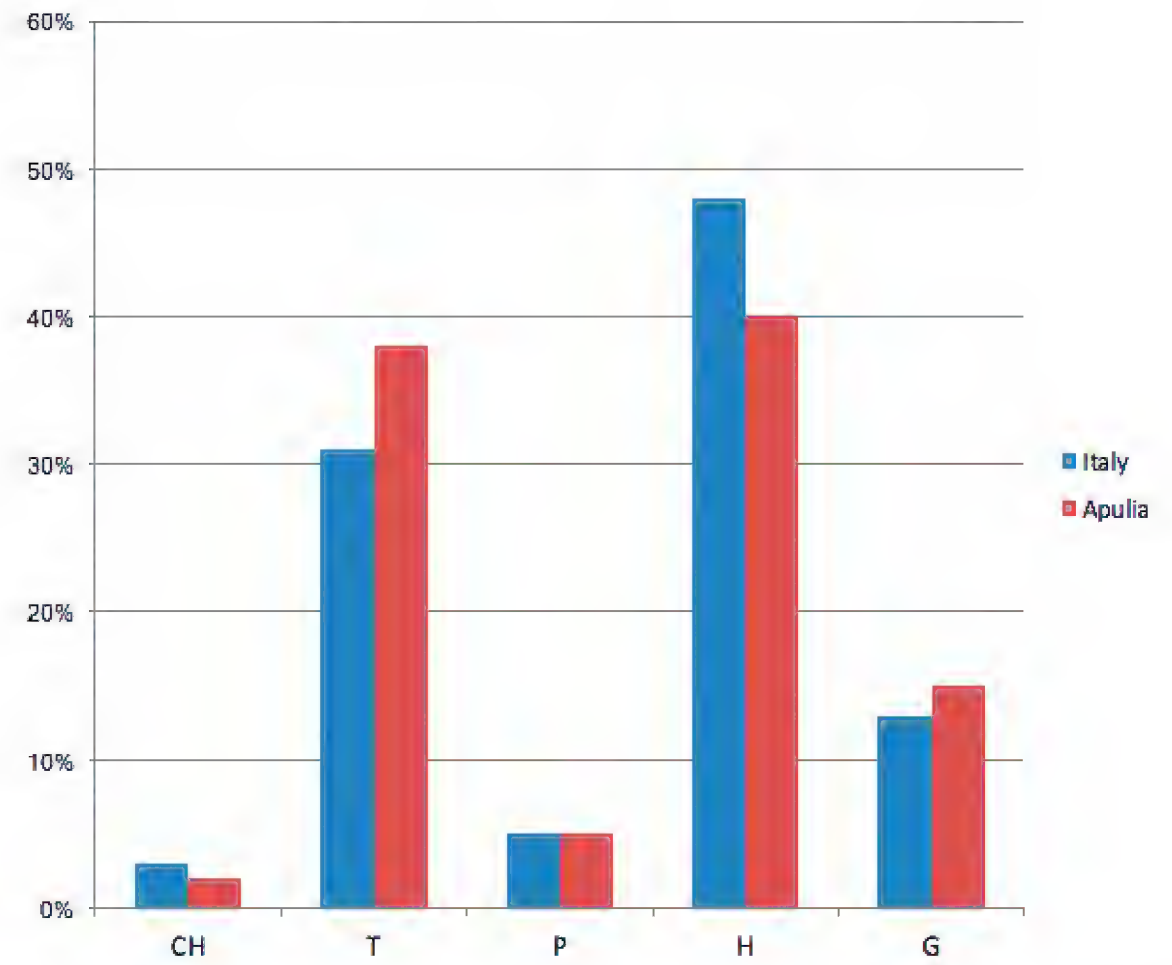

Figure 5. Comparison of the biological forms of wild species used in Italy (left) and in Apulia (right), expressed as percentage. **T** therophyte **G** geophyte **H** hemicryptophyte **CH** chamephyte **P** phanerophyte

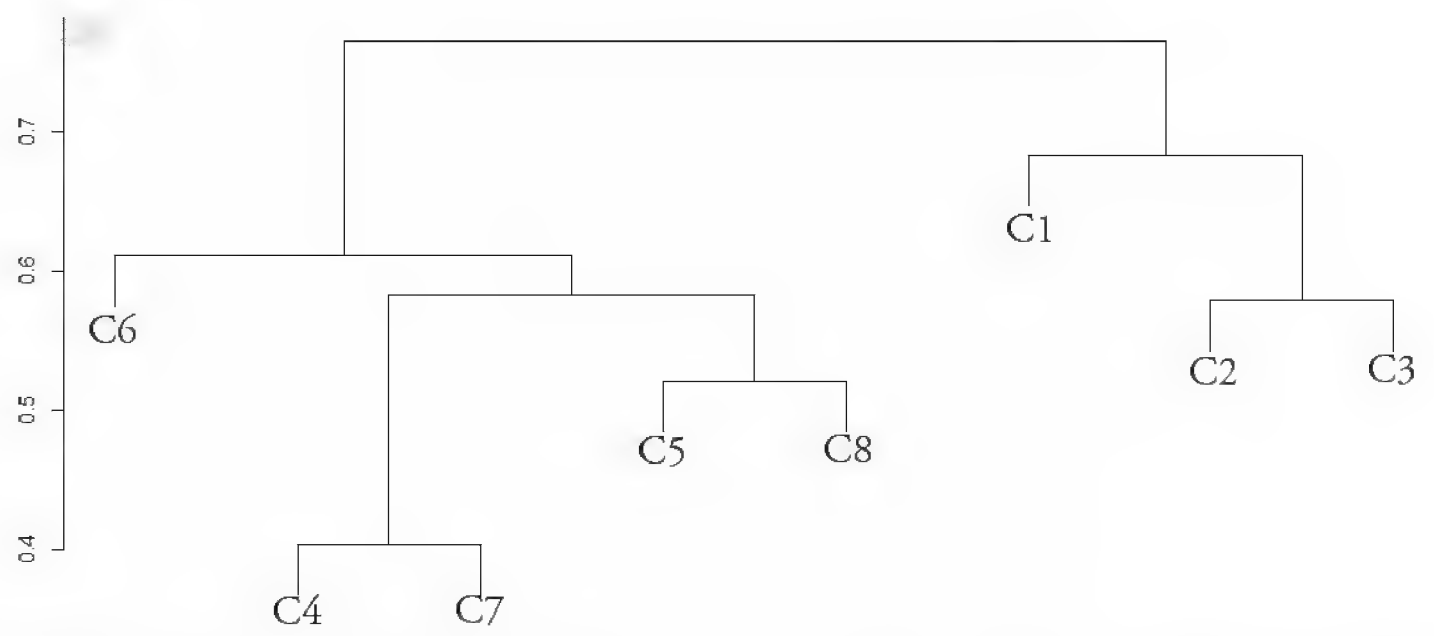

Figure 6. Cluster analysis of spontaneous species used in the eight districts of Puglia **C1** Gargano **C2** Tavoliere delle Puglie **C3** Monti Dauni **C4** Terra di Bari Murgiana **C5** Terra di Bari premurgiana **C6** Valle d'Itria **C7** Salento **C8** Arco ionico tarantino.

found. Wild plants are typically harvested in territories involved in traditional cropping patterns, which are still present in Gargano, Murgia, and Salento. In fact, these harvesting sites are rich in edible species, especially annuals and biennials (*Sonchus* sp., *Crepis* sp., *Urospermum* sp., *Cichorium intybus*). Traditional cropping patterns are, however,

gradually disappearing and, if abandoned, give way to dynamic processes of transformation towards shrubs and then forests. Eventually, such changes cause a strong reduction in edible species. Even though these natural systems are nowadays only a small fraction of the Region as a whole, people still collect wild plants from forests; in fact, Apulia has, among the Italian Regions, the lowest ratio (8 %) between forests and total land area (Regione Puglia 2005).

People who still harvest and eat such plants are primarily the elderly. In our interviews, though, we documented a rising interest for these plants also among the 40- to 60-year olds. There is no interest at all, instead, amongst younger people (< 25) to such an extent that this knowledge could very likely be lost in the future, as already noted in the European ethnobotanical literature (Tardìo et al. 2006, Della 2006, Hadjichambis 2008, Schunko and Vogl 2010, Łuczaj 2012, Caneva et al. 2013, Cassandra and Pieroni 2015, Dolina et al. 2016, Raivo and Sõukand 2016). Therefore, education, either in or outside schools, is needed to preserve it. This particular knowledge is also intimately connected with local dialects, which, in fact, are less and less spoken. Indeed, local languages are critical to understand the biocultural diversity of the local communities, deeply rooted in plant uses. In addition to this, some of these dialects show linguistic influences (Franco-provencals and Griko) that are fundamental to ethnobotanical research. It is noteworthy that the Franco-provencal community living in Monti Dauni is the only one of its kind in central and southern Italy (De Salvio 1908, Valente 1972, Lopane 2014).

Worthy of mention is the existence of the "terrazzani", who are representatives of communities made of very poor people that make ends meet by harvesting wild natural products (fruits, wild greens, mushrooms, snails, and bushmeat).

In our interviews, we documented a gradual lowering in the number of species used as food: people no longer eat 30 of them, but do remember eating them in the past. Ten species are not even remembered by the interviewees, but are clearly documented in literature (Baselice 1812, Bruni 1857, Corrain 1962, Lecciso 1983, Pece 2005). Still, if we consider that, on average, the number of food taxa is quite high here and that the Region has a predominant tertiary sector, the Traditional Ecological Knowledge (TEK) (Heckler 2012) in Apulia is still at a reasonably high level. Indeed, the present study shows that people in Apulia are familiar with and use up to 214 taxa, only 37.9% of the 571 taxa defined as potentially edible (Bianco et al. 2009) in the Apulian flora, namely 2,544 species (Bartolucci et al 2018).

Nowadays, consumers consider wild plants as supplementary components in recipes that also contain cultivated plants, as already pointed out in the ethnobotanical literature of the Mediterranean area (Hadjicambis et al. 2008). In Apulia, however, wild and cultivated plants in the common sense are not distinguished from one another: they are the same, at least from a cultural point of view (Baselice 1812). In fact, both are called "fogghjiè" in local dialects. Thus, in Apulia, wild vegetables have represented and still represent a fundamental part of the Mediterranean diet.

Here, these species have always been part of the local diet (Baselice 1813) and nowadays the large demand coming particularly from the catering sector has stimulated e.g. the installation of several Salicornia cultivations in Gargano (Urbano et al. 2017).

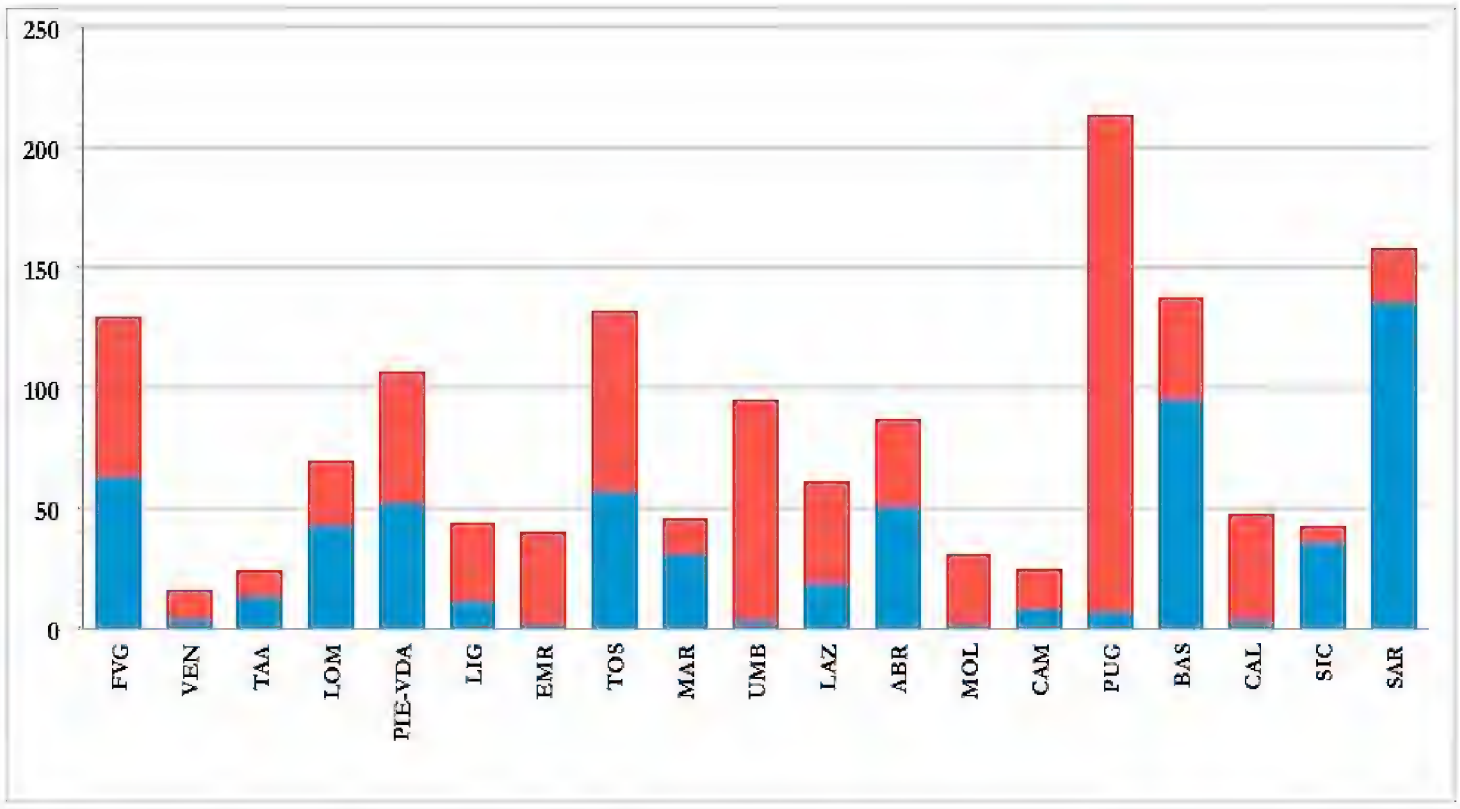

Figure 7. Number of wild species used in Italian regions: in blue the taxa in Guarrera (2006b) are shown; red bars show data from the present work, based on several recent analyses of Italian Regions (2006–2017).

The domestication of this species has great economic prospects and, from an agronomical point of view, it is strategic for the use of high-salinity soils.

It is worth mentioning that the food use of *Clematis vitalba* has been previously reported in several Regions of northern Italy (Dreon and Paoletti 2009), central Italy (Pieroni 2000, Lentini and Venza 2007; Ranfa and Bodesmo 2017), and in Sicily (Lentini and Venza 2007). It has recently been documented also in the communities of the Croatian coast (Dolina et al. 2016). Therefore, the fact that we report it also in Apulia shows that communities did not eat only edible plants but also parts of toxic plants, e.g., shoots of *Clematis* sp. containing less protoanemonin, a compound irritating skin and gastrointestinal mucosa (Chawla et al. 2012).

It is noteworthy that the largest gap between previous and current ethnobotanical knowledge is, among Italian regions, for Apulia (Fig. 7). Our investigation, conducted on the whole Regional territory, could have been a crucial factor and studies of this kind are, therefore, strongly recommended for the other Italian Regions. The importance of the presented update for some species is striking: for instance, several authors documented the use of *Silybum marianum* in all Italian Regions, as opposed to the work of Guarrera (2006b) who recorded it only in Basilicata, Lazio, Lombardia, and Sardegna. The same is true for *Reichardia picroides* (Puglia, Sardegna) and *Portulaca oleracea*, which were previously reported only in Lazio, Friuli Venezia Giulia, and Sardegna, but recently shown to be used as food throughout Italy (Bosi et al. 2009). Leaves of *Crepis* sp. turn out now to be cooked in soups all over Italy and not just in northern parts of the country. Furthermore, food use of *Hyoseris radiata* L. was documented only in Liguria and Trentino Alto Adige, while we now also report it in Marche, Toscana, Sicilia, Sardegna, Umbria, and Puglia. Finally, *Reichardia picroides* should be considered

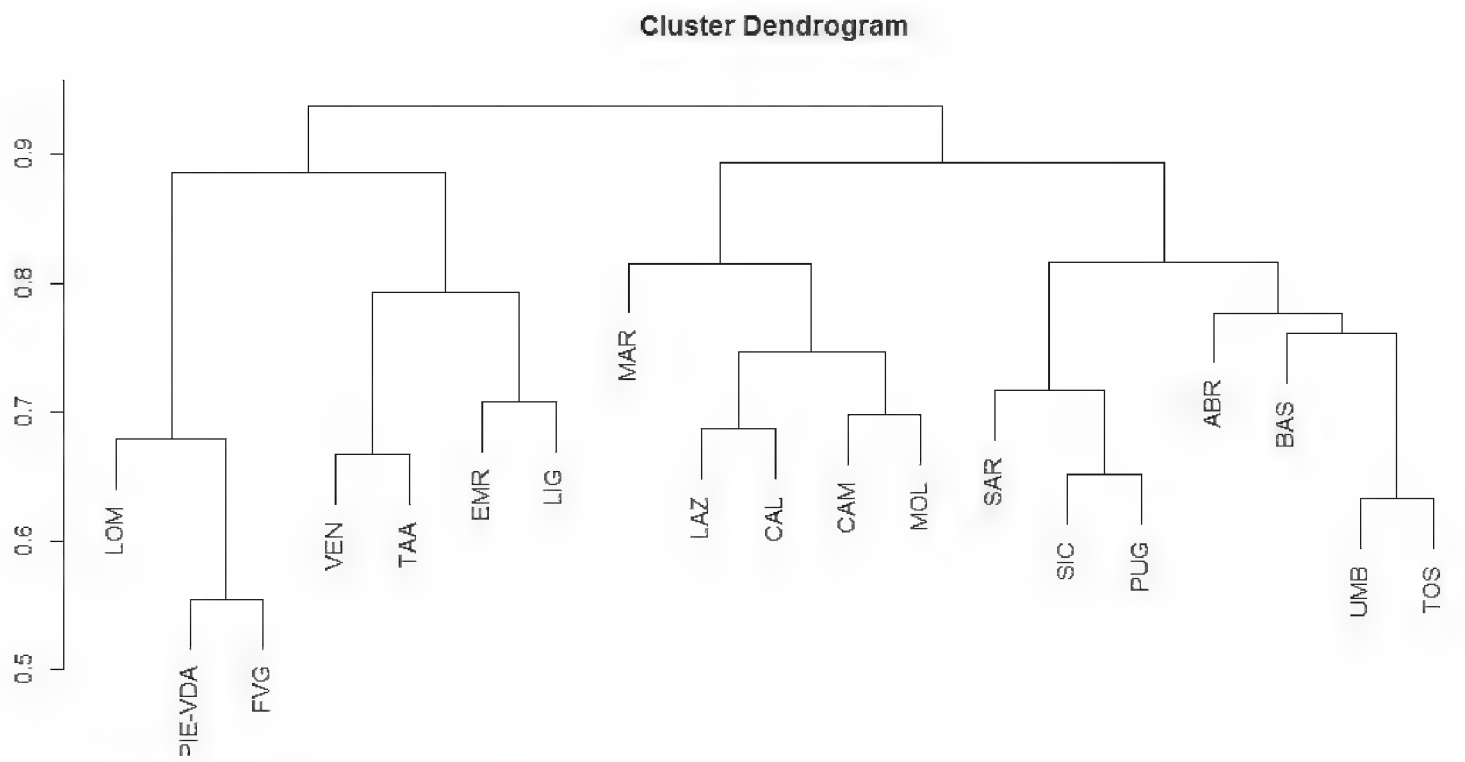

Figure 8. Hierarchical cluster analysis dendrogram of species on a Regional basis.

Figure 9. Venn diagram with food taxa used in Apulia, Sicilia and Sardegna.

as one of the most typical food species of southern Italy, while in older reports its use was documented solely in Liguria and Marche.

Among Italian regions, Piemonte, Friuli Venezia Giulia, and Aosta in northern Italy and Puglia, Sicilia, and Sardegna in southern Italy are homogeneous (Fig. 8). As further evidence, the similarities in the latter group are represented in the Venn diagram (Fig. 9). The causes of these similarities are not easy to explain and may represent a starting point for future research.

Table 2. Distribution of food taxa in Italian macro-regions.

Macro-regions	N° taxa (%)
northern Italy	204 (37.2)
central Italy	193 (35.2)
southern Italy	398 (72.7)

Finally, the total count of 828 food units for Italy may be doubtful because of the lack of updated investigations on a national scale. In our opinion, this number is merely an approximation. According to our methodology, wild plants used as food would then be 539 taxa (only 300 according to Guarrera 2006b), 23 of which at subspecific rank (e.g., *Crepis vesicaria* L. subsp. *taraxacifolia* (Thuill.) Thell.). It is, therefore, important to note that popular knowledge can provide a deep understanding of the rich taxonomical diversity of the flora of each territory.

Table 2 shows the resulting taxa (539) divided by macroregion; the highest number is found in southern Italy. As opposed to what was previously reported (Caneva et al. 2013), the Asteraceae are predominant in every macroregion (northern Italy = 22 %, central Italy = 31 %, southern Italy = 29 %). The percentage of Brassicaceae, instead, is higher in southern Italy (11 %) than in the other areas. Moreover, only 6 % of the food taxa used in northern Italy is made up of Rosaceae. Thus, this family ranks third, right after the Brassicaceae (8 %), while it is nearly irrelevant in southern Italy (2 %). To sum up, the Rosaceae prevail in northern Italy and Asteraceae/Brassicaceae in southern Italy, if one includes fruit species and parts of aromatic plants.

Conclusions

Our investigation highlights the fact that culinary use of wild plants has still a strong tradition in Apulia not only in the rural population, but it is widespread all over the territory. Moreover, the use of some species and the respective culinary preparations characterise each area, thereby representing a fundamental part of the local gastronomy. We also observed that a common knowledge about these uses does not exist: in fact, only 19 of the 214 food taxa examined are used in all eight districts. In addition, wild greens are sold as common vegetables in several towns; they are as important as cultivated ones in constituting the Mediterranean diet that characterises this Region, thanks to a tradition that has historically been giving value to these products. In our opinion, a better knowledge about food use of wild species can only be gained through a systematic analysis, such as the one reported here.

Our results point to the existence of a rich and diversified tradition in Italy, as expressed in the numerous culinary preparations. The species having a proper use as food in the various Italian Regions can be grouped in 539 taxa, excluding fruits and aromatic plants. Ethnobotanical research is increasingly becoming fundamental to explore the TEK, also expressed by the local names of plants. This field of study is crucial

if we want to preserve the dialects that people in Italy are progressively forgetting and, accordingly, the associated knowledge about food use of wild vegetables.

The results of this investigation conducted in Apulia can prove that food use of plants in Italy has been only partially documented:

1. several territories still have to be thoroughly explored in this sense (e.g., areas in the Alps and Apennines, rural and suburban areas);
2. further investigations on a regional scale are needed;
3. there is a need to update and verify the existent literature, as well as to uniform the methods of investigations in order to obtain more homogeneous data.

Notwithstanding, a rich literature about the cultural, gastronomic, economic, and agronomic value of wild vegetables is nowadays available. However, little has been done to exploit their potentialities. Several authors of ethnobotanical studies have been calling for new initiatives to preserve and promote these uses. Therefore, the successful domestication of "salicornie" in the Gargano area and its commercial success is of great interest.

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Supplementary material I

Tables S1, S2, S3

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Data type: Document PDF

Explanation note: Table S1 (Learning areas divided by territorial district), Table S2 (Wild vegetables gathered and consumed in Apulia region) and Table S3 (Wild food plants of popular use in Italy by regions (Checklist)).

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